INSERM U1008
Biomaterials Research Group

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Lille

Biomat-IN Special Interest Group Wound
Inserm U1008, Pr Juergen Siepmann, Director

Drug Delivery System and Biomaterials

Pr M.P. Flament, Dr F. Siepmann,
Dr S. Muschert, Dr Y. Karrout, M. H. Florin

Development of new forms for the control release of drug

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Functionalisation of biomaterials, in vitro and in vivo evaluation
Tissue Engineering

CMF-Stomatology
Pr. J. Ferri, Pr G. Raoul

Vascular surgery
Pr. S. Haulon, Dr B. Maurel
Dr. J. Sobocinski

Parodontology
Pr. E. Delcourt

Implants
Pr. E. Deveaux

FED 4123 (F. HILDEBRAND)
Fédération des biomatériaux et dispositifs médicaux fonctionnalités
Our activities

- Evaluation of the cytocompatibility of functionalized medical devices and biomaterials (*in vitro* et *in vivo*)
- Surface functionalization of biomaterials (in partnership with the laboratory of the Biomaterials federation)
- Evaluation of the kinetics of adsorption and drug release
- Evaluation of the *in vitro* and *in vivo* therapeutic activity of functionalized medical devices (antibacterial, anti-proliferative, anti-thrombogenic, analgesics activities,)
- Tissue Engineering
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Functionalisation of biomaterials, in vitro and in vivo evaluation
Tissue Engineering

✔ Polyester Vascular Prostheses
  - Development of an antibacterial graft

✔ Metallic Stent
  - Development of an antithrombogenic stent
  - Development of a drug eluting stent

✔ In vitro and ex vivo evaluation of stent
Macroporous scaffold

- Development of functionalized scaffold for anticancer application (Cyclodextrins, microparticles)
- Development of a bio-resorbable hydrogel

Tissue Engineering
Wound dressing

State of art

- Wounds and burns: public health problem
- Prevalence: 2-3% in the world
- Serious complications (amputation, septicemia, mortality)
- Wound → Modification of the local physico-chemical conditions (pH, temperature, moisty,…) → Bacterial infection

Strategy

- Construction of a Layer-by-Layer system (LbL) on a polyester textile functionalized by chitosan and activated with ionic silver (PET-CHT-Ag)
  - Antibacterial activity
  - Optimal moisty
  - Barrier function
**Textile Functionalisation**

**Pad-dry-cure process**

- **Impregnation**
  - CHT (2.5%-wt)
  - CTR (1 or 10%-wt)

- **Padding**

- **Drying**
  - 90°C 5 min

- **Crosslinking**
  - 140°C 15 min

- **Washing**

**PET : Chemically inert → Fiber coating**

- Cationic Charges -NH₃⁺ (CHT)
- Anionic Charges -COO⁻ (CTR)
**Textile characterisation**

**Quantification of the reactive functions**

- CHT 2.5%\textsubscript{w/w}
- 140°C, 15 min

**Cytocompatibility**

**Antibacterial activity**

*Ag 0.13 mg/cm²*

**Kill time test**
Textile functionalization

Multilayer system

- Layer-by-Layer (Lbl)
- Cyclodextrin polymer
  - Anionic + complex of inclusion
- Chitosan
  - Cationic

Barrier function/Ag⁺
Textile characterization

Linear construction of the L-b-L

Weight gain, %

Pairs of Layers

PET-CTR10/CHT
PET-CTR10/CHT-Ag

Chlorhexidine

Chlorhexidine released, %

Time, days

PET5,5
PET7,5
PET10,5

Inhibition diameter, mm

T0 heure
T72 heures

PET-CTR10/CHT
PET-CTR10/CHT-MC
PET-CTR10/CHT-Ag
PET-CTR10/CHT-Ag-MC
Conclusion

- Functionalization of chemically inert fiber with chitosan
  - Adjustable system—Cationic or anionic charge
  - Cytocompatible
  - Antibacterial activity with silver

- Build-up of the multilayer system
  - Natural and biocompatible polymers
  - Antibacterial activity preserved
  - Swelling properties and barrier effect obtained
  - Multidrug system

- Next step
  - In vivo assays (infected mouse model)